Goldbach's Conjecture Proof

Abstract

Through the application of my algorithm, Goldbach's Conjecture is proven true. This paper explains the algorithm then applies the algorithm with examples. The final section of the paper proves Goldbach's Conjecture

Keywords: Goldbach; Algorithm; Number Theory; Mathematics

Introduction

Goldbach's Conjecture states that all even integers greater than 2 are the sum of two prime integers (hereafter, referred to as "prime" or "primes"). This is one of the oldest unproven conjectures because, although even integers have been tested to large values, it takes one example of an even integer that is not the sum of two primes to prove the whole conjecture false. To prove Goldbach's Conjecture, it is important to show that what happens to one even integer happens to all even integers; making the final statement universal.

Algorithm Description:

The purpose of the algorithm is to eliminate all even integers that are not the sum of one particular prime plus any other prime.

Definitions:

Algorithm prime- the particular prime to which the algorithm is being applied.

Eliminated- not the sum of the algorithm prime plus any other prime.

Strand-having a starting point from which numbers are systematically eliminated. Strands are exclusive to the algorithm prime.

Starts with- the starting point of each strand. Do not eliminate this point.

Skips by- the increment by which even integers are eliminated. Strand 1 always skips by 6.

Significance- the first even integer that is not eliminated after applying previous strands. These points can be found by using: 8*[Number of Current Strand]+[Previous Significance]= [Current Significance]. The first significance point's "previous significance" = the algorithm prime +1. The number of significance points equals the number of strands needed. Significance points can act as a shortcut for the algorithm (see "Note 2").

Equal sets- Sets that contain one another; containing the same elements.

Algorithm

Strand 1 starts with an integer (determined by adding 3 to the algorithm prime), and eliminates the even integers that skip by 6 from the starting point. The strands thereafter are the previous "starts with" +2 and the previous "skips by" +4.

Example

Our example desired maximum integer is 53 and the example algorithm prime is 3. First determine how many strands are needed:

First significance point: 8*(1)+[3+1]= 12

Second significance point: 8*(2)+12= 28.

Third significance point: 8*(3)+28= 52.

To ensure we do not need one additional strand to reach our desired max integer (53), one can see where the 4th strand would become significant: 8*(4)+52= 84. This means we only need three strands of the algorithm to find all the even integers that are not the sum of 3 + another prime between 0 and 53.

The first strand starts with 3+ the algorithm prime (3) and skips by 6. So, starting with 6, we eliminate 12, 18, 24, 30, 36, 42, 48. Strand 2 starts with +2 and skips by +4 more than the last: starting on 8, skip by every 10th number, eliminating 18, 28, 38, 48. The third strand starts on 10 and skips by 14, eliminating 24, 38, 52. Some even integers are eliminated more than once, so look to “Note 2”. The remaining even integers are the sums of 3+ one other prime.

Discussion

The example accounts for the even integers that are the sum of one prime plus 3. This does not include even integers that are the sum of one prime plus 5, or one prime plus 7, etc.

Note 1: 2 cannot be an algorithm prime; besides 2+2, 2+ any other prime is odd.

Note 2: To use significance points as a shortcut, apply strand 1 and then simply eliminate even integers from each strand’s significance point onward.

Note 3: Simply applying the first strand of the algorithm simultaneously to the primes 3,5,7 demonstrates the algorithm's ability to eliminate all even integers greater than or equal to 12. The algorithm can also be applied in retro (eliminating increments of the "skips by" number backward from the starting point rather than forward). This would eliminate 2,4,8,10 when applying the first strand of the algorithm to the primes 5,7,11 and 13. The even integer 6 is eliminated in retro by applying the second strand of the algorithm to 11. Now all even integers are eliminated. This note is only important in regard to the proof.

Algorithm Eliminating All Even Integers Greater Than 12

Algorithm Applied To	Starts With	Skips By	Result: All Even Integers Above 12 are Eliminated								
3	6	6	12	18	24	30	36	42	48	54	*Continued Indefinitely...*
5	8	6	14	20	26	32	38	44	50	56	
7	10	6	16	22	28	34	40	46	52	58	

Figure (1)

Applying Algorithm To Consecutive Primes

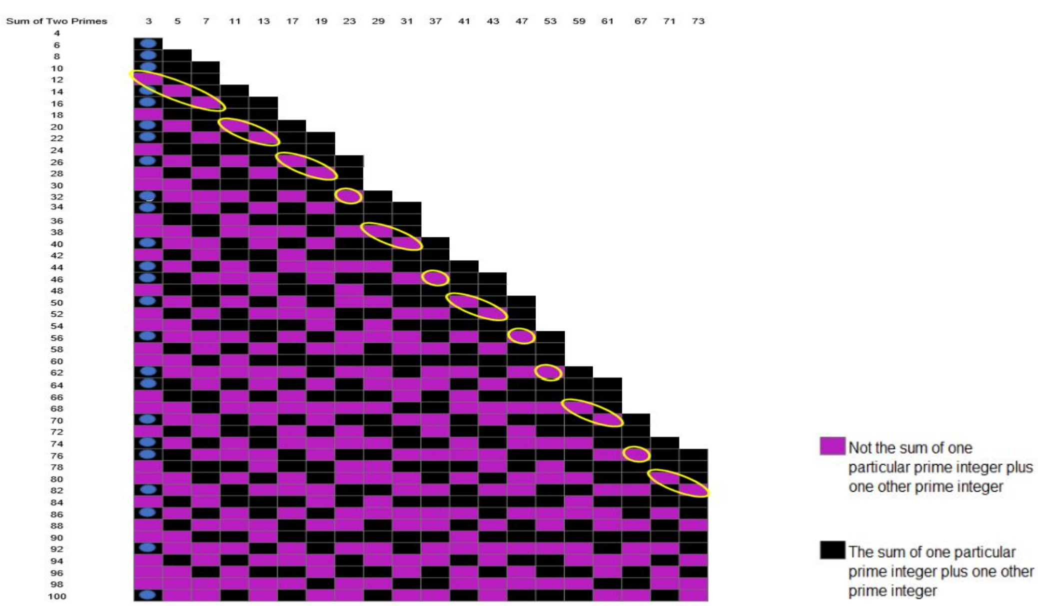

Figure (2)

This chart continues indefinitely vertically down and horizontally to the right. It has been abbreviated for the purpose of this paper.

Results

Prime spacing is not random; as is displayed by the algorithm's systematic elimination of even integers. When applying the algorithm to 3, the even integers that are not eliminated map consecutive primes (consecutive even integers that have not been eliminated, minus 3, are equal to consecutive primes).

Even integers that are the sum of individual primes (vertically) plus one other prime (horizontally) are shown in black. The even integers which my algorithm eliminates are also displayed and are shown in purple. Both displays follow the same pattern. This pattern is the spatial mapping of primes (3,2,2,1,2,1,2,1,1,2…).

Because the algorithm eliminates all even integers, which is a universal statement, the best choice for proving Goldbach's Conjecture is: proof by contradiction.

Conjecture: For all (n), such that n > 2 and n is an even integer, n is the sum of two primes.

Proof

Assume no even integers are the sum of two primes.

There exists three sets: the set that contains even integers that are the sum of two primes (set "A"), the set that contains even integers that are not the sum of two primes (set "B"), and the set of all even integers (set "C").

For every prime to which the algorithm has been applied, the even integers that are not the sum of that prime plus one other prime are eliminated.

If the even integer has been eliminated, then it belongs to set B.

The algorithm, when applied to all primes simultaneously, contains the set of all even integers.

No individual application of the algorithm contains all eliminated even integers; all even integers are eliminated.

This is evident by figure 1. However, also consider applying the algorithm to the largest prime. The even integers greater than 2 and less than 3 + the largest prime (the first "starts with" point) are not included; they are eliminated. Since primes are infinite, even integers are infinitely eliminated.

If all even integers are eliminated, then no even integer is the sum of two primes.

Now consider [A]+[B]=[C].

C contains A and B. (1)

B follows a pattern that eliminates all even integers. So, B contains C. (2)

A follows the same pattern as B. So, A contains C.(3)

Following the same pattern that eliminates all even integers suggests all even integers are eliminated. However, by definition of "the set that is the sum of two primes", no even integers are eliminated.

Because (1),(2), and (3) are true, the sets contain each other. A=C and B=C, so A=B=C by definition of equal sets.

However, this is a contradiction.

"All even integers are the sum of two primes" and "No even integers are the sum of two primes" cannot both be true.

Since 3 is a prime, 5 is a prime, 8 is an even integer, and 8=3+5, B=C is false.

Therefore, all even integers are the sum of two primes and Goldbach's Conjecture has been proven true.